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THE EFFECTS OF THE INDUSTRIAL PROCESSING OF THE TOMATO PASTE AND TOMATOE JUICE ON THE C VITAMIN CONTENT

EFECTELE PROCESĂRII INDUSTRIALE A PASTEI DE TOMATE ŞI A SUCULUI DE ROŞII ASUPRA CONÎINUTULUI DE VITAMINA C

GOCAN Tincuța-Marta[1], ANDREICA Ileana[1], POŞTA G[2]., RÓZSA Melinda[3], RÓZSA S.[1*]
e-mail: drd.rozsa.sandor@gmail.com

Abstract. *Nowadays, C vitamin deficiency is much higher than in the past centuries, primarily due to the explosion of processed foods, frozen foods, fast food foods and those cooked for a long time that cannot provide the body with an intake enough vitamins. We no longer eat fruits, for example, but we consume packaged fruit juices, which, due to pasteurization and preservation, largely lose their vitamins. In the present paper, the content of C vitamin in processed tomatoes at different temperatures and for different periods of time was followed. As the processing temperature increases, there is also an increase in C vitamin loss. Maximum C vitamin loss occurred in 15 minutes of heating at 100 °C, and when the processing temperature drops, the additional C vitamin loss rate becomes smaller.*
Key words: tomato, processing, storage, C vitamin.

Rezumat. *În zilele noastre, deficitul de vitamina C este mult mai mare decât în secolele trecute, în primul rând datorită exploziei de alimente procesate, înghețate, alimentelor de tip fast-food şi a celor gătite pentru foarte mult timp, care nu pot aduce organismului un aport suficient de vitamine. Nu mai mâncăm fructe, spre exemplu, ci consumăm sucuri de fructe ambalate, care datorită pasteurizării şi conservării îşi pierd în mare parte vitaminele. În lucrarea de față s-a urmărit conținutul în vitamina C la tomatele prelucrate la diferite temperaturi şi pentru diferite perioade de timp. Pe măsură temperatura de procesare creşte, se constată şi o creştere a pierderii de vitamina C. Pierderea maximă a vitaminei C a avut loc în 15 minute de încălzire la 100 ºC, iar la scăderea temperaturii de procesare, rata suplimentară de pierdere a vitaminei C devine mai mică.*
Cuvinte cheie: tomate, procesare, păstrare, vitamina C.

INTRODUCTION

Food safety is one of the most important factor that contributes to the health of the population, to the reduction of the illnesses and, implicitly, to the costs of the health system, as well as to the improvement of the quality of life in our country.

[1] University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, România
[2] SC CIUPERCĂRIA SRL, Aghireşu-Fabrici, Cluj County, România
[3] Banat University of Agricultural Sciences and Veterinary Medicine, Timişoara, România

C vitamin is very essential for the growth and maintenance of the human body. It is necessary for the normal formation of protein collagen, which is an important constituent of skin and connective tissue. The deficiency of C vitamin causes widespread connective tissue abnormalities (Srivastava and Verma, 1991). They include swelling of the gums, which become soft, spongy and bluish red in colour.

Lesser important sources are sprouts during germination of seeds, cauliflowers, tomatoes and potatoes (Chatwal, 1988).

Oxidation reactions are essential for life, but they produce reactive oxygen species that can cause significant damage to cells. Therefore, complex protection systems have evolved based on antioxidants that help to eliminate these dangerous molecules (Ropciuc *et al., 2011*).

Oxidative stress plays a role in many human diseases, but its impact can be reduced by the consumption of dietary antioxidants such as ascorbic acid (AsA), which is also known as C vitamin (Giovannucci, 1999).

As well as providing health benefits to humans, higher AsA levels improve both biotic and abiotic stress tolerance in plants (Kuzniak snd Sklodowska, 2005) and enhance postharvest fruit quality. The content of C vitamin may vary, under conditions of high humidity and low temperature (Chrubasik *et al.*, 2006).

High C vitamin content (300-4000 $mg100g^{-1}$) of fruit of rosehip and other substances ensure the normal functioning of the endocrine glands, brain, heart and liver. Ascorbic acid has an important role in the absorption of iron in the body in the biosynthesis of collagen. Due to the presence of C vitamin, fruit of rose hips traditionally are used as a tea in cold weather to prevent and fight fevers and colds (Sies, 1997).

Tomato (*Lycopersicon esculentum*) is one of the most consumed vegetables (botanically a fruit) per capita in the world, second only to the potato. Owing to the high level of consumption, tomatoes are a significant source of C vitamin (19 mg 100 g^{-1} fresh weight (FW)), A vitamin (623 IU 100 g^{-1} FW), carotenoids (USDA/NCC) and flavonoids in the diet.

The main flavonoids found in tomatoes are quercetin and kaempferol. Quercetin predominates, with levels ranging from 0.03 to 2.76 mg 100 g^{-1} in fresh tomatoes and from 0.50 to 4.12 mg 100 g^{-1} in processed tomato products (EUNMI *et al.*, 2011).

MATERIAL AND METHOD

Total soluble solids (TSS) and were determined using the refractometric method, with an Abbe refractometer and corrected to the equivalent reading at 20 ºC (Lazăr, 2015). Determination of the C vitamin in fresh tomatoes, tomato paste and tomato juices by this method compared favourably with similar analyses using the standard indophenol titration method (Lazăr, 2015). In the experiment, tomato juices were heated to 60 ºC, 80 ºC, 90 ºC and 100 ºC for different periods of time: 15', 30' and 45'. Tomato paste was purchased from the supermarket. Because it was desired to monitor the amount of C vitamin after applying the treatments, depending on time, these were only followed for tomato juice which was produced in the laboratory.

RESULTS AND DISCUSSION

The results for the soluble dry substance and C vitamin content were determined immediately after harvesting the tomato fruits, after obtaining the juice for tomato juice and immediately upon opening the container for tomato paste. It can be seen that the C vitamin content of tomato juice decreases quite a lot, because much of it remains in the fruit's skin. In case of tomato paste, following processing, C vitamin content is corrected with other ingredients which are added to in the production cycle (tab.1).

Table 1

Content of dry matter and C vitamin, in tomato products

Sample	Dry matter ºBx	C vitamin
Fresh tomato	4.9 ± 0.3	19.76 ± 0.27b
Tomato Juice	4.8 ± 0.1	12.59 ± 0.41c
Tomato paste	17.5 ± 0.2	27.54 ± 1.81a

In table 2 is presented the effect of heating for tomato juice at 60 ºC for different periods, the retention and the loss of ascorbic acid. The highest losses in C vitamin are recorded at 45 minutes. The smallest losses are within 15 minutes (7.5 mg $100ml^{-1}$).

Table 2

Effect oftomato juices heating to 60 ºC for different periods of time on the retention/loss of ascorbic acid

Time of heating (min)	C vitamin mg 100 ml^{-1}	Retentions of C vitamin mg 100 ml^{-1}	Loss of C vitamin mg 100 ml^{-1}
0	15.6	100	0
15	14.4	92.5	7.5
30	13.4	86.3	13.7
45	12.3	79.4	20.6

But in the later stage of heating, steaming atmosphere over the surface of tomato juice and the absence of dissolved oxygen, reduce the loss of ascorbic acid. As compared to other fruits, maximum loss of ascorbic acid has been found in later part of the heating (tab.3).

Table 3

Effect oftomato juices heating to 80 ºC for different periods of time on the retention/loss of ascorbic acid

Time of heating (min)	C vitamin mg 100 ml^{-1}	Retentions of C vitamin mg 100 ml^{-1}	Loss of C vitamin mg 100 ml^{-1}
0	15.6	100	0
15	11.8	75.9	24.1
30	11.3	72.5	27.5
45	10.7	69.0	31.0

Retention of C vitamin per 100 ml of juice, recorded the best value at 15 minutes time (tab. 4). C vitamin decrease with the increase of boiling time.

Table 4

Effect oftomato juices heating to 90 ºC for different periods of time on the retention/loss of ascorbic acid

Time of heating (min)	C vitamin mg 100 ml^{-1}	Retentions of C vitamin mg 100 ml^{-1}	Loss of C vitamin mg 100 ml^{-1}
0	15.6	100	0
15'	9.9	63.5	36.5
30'	9.4	60.7	39.3
45'	8.7	55.9	44.1

It can be seen that the initial amount of C vitamin (15.6 mg 100 ml-1) at 100 ºC temperature, and 45 minutes of boiling, the C vitamin contents decrease approximately with 10 mg 100 ml-1 (tab. 5). For these samples, the determined retention of C vitamin was 37.9 mg 100 ml-1.

Table 5

Effect oftomato juices heating to 100 ºC for different periods of time on the retention/loss of ascorbic acid

Time of heating (min)	C vitamin mg 100 ml^{-1}	Retentions of C vitamin mg 100 ml^{-1}	Loss of C vitamin mg 100 ml^{-1}
0	15.6	100	0
15'	8.2	53.1	46.9
30'	6.5	42.1	37.9
45'	5.9	37.9	62.1

CONCLUSIONS

1. As the heating is increased, the loss of C vitamin also increases.

2. The maximum loss of C vitamin has been takes place in the first 15 minute of heating, regardless of the temperature at which it heats up, then further rate of C vitamin loss becomes lesser.

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